UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EXPOSURE RESEARCH LABORATORY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
RESEARCH AND DEVELOPMENT

September 13, 2017

MEMORANDUM

SUBJECT: Laboratory PFAS Results for NC DEQ Chemours Test Well Samples

FROM: Timothy J. Buckley, Director
Exposure Methods and Measurements Division

THRU: Jennifer Orme-Zavaleta, Director
National Exposure Research Laboratory

TO: Julie S. Woosley, Chief
Hazardous Waste Section
North Carolina Department of Environmental Quality

Per your email request of July 21, 2017, attached please find our laboratory analysis report of PFAS concentration results for sampling on or near the Chemours-Fayetteville, NC facility. These results are a part of a larger effort in support of NC DEQ that has included 4 previous reports providing PFAS results from sampling along the Cape Fear River upstream and downstream of Chemours.

Thank you for inviting us to be a part of this effort that addresses a very important public health concern in North Carolina. These results represent the effort of many within our lab, but I would especially like to acknowledge Drs. Mark Strynar, Andy Lindstrom, James McCord, Johnsie Lang, and Seth Newton in conducting the laboratory analyses, Dr. Myriam Medina-Vera who provided invaluable support and coordination, and Ms. Sania Tong Argao who supported and oversaw quality assurance.

If you have any questions or concerns, do not hesitate to contact me at (919) 541-2454 or email buckley.timothy@epa.gov. I look forward to our continued work together.

Enclosure

CC: Linda Culpepper, NC DEQ Deputy Director
Becky B. Allenbach, USEPA Region 4
Jeff Morris, USEPA OPPT
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Peter Grevatt, USEPA, OW
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Summary of Results

PFAS water concentration results are reported for 19 sites on or near the Chemours Fayetteville, NC facility. We understand that these samples were collected by Chemours staff under the observation of your staff during the week of July 31, 2017. Samples were delivered to our laboratory on August 3rd and 4th. For these samples, we did not provide sample containers nor did we provide field blanks or spikes, so our assessment of quality control is limited. We report the concentration of 16 analytes using two methods, i.e., targeted and non-targeted analysis. For the targeted analysis, we report concentrations for 11 analytes (Table 1). For these targeted analytes, concentrations and chemical identity were determined with high certainty based on reference standards and a calibration curve.

Table 1. PFAS Measured Using Targeted Analysis

Short Name	Chemical Name	Formula	CAS #	Monoisotopic Mass (Da)
GenX	Perfluoro(2-methyl-3-oxahexanoic) acid	$C_6HF_{11}O_3$	13252-13-6	329.9750
PFBA	Perfluorobutyric acid	$C_4HF_7O_2$	375-22-4	213.9865
PFPeA	Perfluoropentanoic acid	$C_5HF_9O_2$	2706-90-3	263.9833
PFHxA	Perfluorohexanoic acid	$C_6HF_{11}O_2$	307-24-4	313.9801
PFHpA	Perfluoroheptanoic acid	$C_7HF_{13}O_2$	375-85-9	363.9769
PFOA	Perfluorooctanoic acid	$C_8HF_{15}O_2$	335-67-1	413.9737
PFNA	Perfluorononanoic acid	$C_9HF_{17}O_2$	375-95-1	463.9705
PFDA	Perfluorodecanoic acid	$C_{10}HF_{19}O_2$	83-89-6	513.9673
PFBS	Perfluorobutanesulfonic acid	$C_4HF_9SO_3$	206-793-1	299.9503
PFHxS	Perfluorohexanesulfonic acid	$C_6HF_{13}SO_3$	355-46-4	399.9439
PFOS	Perfluorooctanesulfonic acid	$C_8HF_{17}SO_3$	1763-23-1	499.9375

Non-targeted results are reported for 5 analytes (Table 2). For these non-targeted analytes, standards are not available. Therefore, the concentration of these analytes is estimated assuming that the mass spectrometer is responding to the non-targeted analyte as it responds to GenX (see Equation 1). Accordingly, the concentration estimates of the non-targeted analytes are considered semi-quantitative. For non-targeted analytes, the actual instrument response may be weaker or stronger resulting in an under- or over-estimation of their concentration. Based on experience with this class of analytes, we conservatively suggest a ~10-fold uncertainty around these estimated concentrations.

Table 2. PFAS Measured Using Non-Targeted Analysis

Short Name	Chemical Name	Formula	CAS #	Monoisotopic Mass (Da)
PFMOAA	2,2-difluoro-2-(trifluoromethoxy)acetic acid	$C_3HF_5O_3$	674-13-5	179.9846
PFO2HxA	perfluoro-3,5-dioxahexanoic acid	$C_4HF_7O_4$	39492-88-1	245.9763
PFO3OA	perfluoro-3,5,7-trioxaoctanoic acid	$C_5HF_9O_5$	39492-89-2	311.9680
PFESA Byproduct 1	Perfluoro-3,6-dioxa-4-methyl-7-octene-1-sulfonic acid	$C_7HF_{13}SO_5$	29311-67-9	443.9337
PFESA Byproduct 2	Ethanesulfonic acid, 2-[1-[difluoro(1,2,2,2-tetrafluoroethoxy) methyl]-1,2,2,2-tetrafluoroethoxy]-1,1,2,2-tetrafluoro-	$C_7H_2F_{14}SO_5$	749836-20-2	463.9399

Equation 1: $$[NTA] = [GenX] * \frac{NTA_{PA}}{GenX_{PA}}$$

Where: [NTA] is the concentration of the non-targeted analyte (ng/L)
[GenX] is the concentration of GenX (ng/L)
NTA_{PA} is the integrated peak area for the non-targeted analyte
$GenX_{PA}$ is the integrated peak area for GenX

Results from both the targeted and non-targeted analysis are provided in Table 3. For 15 of the 19 sampling sites, dilutions of 25X to 100X were required in order to yield concentrations within the range of the calibration curve. Results have been flagged accordingly. Although necessary for quantification, diluting the samples introduces additional uncertainty in the measurement. In some cases, even with dilution, concentrations exceeded the calibration curve. These results are flagged accordingly.

Considerable range in PFAS concentrations was observed across analytes and sampling sites. In general, lower concentrations were observed for the legacy PFAS, from below detection to as high as 2,100 ng/L (Table 3). The shorter chain, new generation PFAS, GenX, was observed at concentrations approximately an order of magnitude higher than the legacy compounds. Estimated concentrations of non-targeted analytes including PFMOAA, PFO2HxA, and PFO3OA ranged even more so, from non-detect to as high as 738,000 ng/L (Table 3).

Although we did not have field duplicates or spikes, method performance was assessed with laboratory blanks (n=6). We did not detect any of the targeted analytes in any of the blanks. GenX was detected in three blanks at concentrations slightly above our detection limit of 10 ng/L, i.e. 12.9, 23.4, and 19.3 ng/L. The laboratory methods for the results reported here are described in Sun *et al.*, 2016[1] and Strynar *et al.*, 2015[2].

[1] Sun M; Arevalo E; Strynar M; Lindstrom A; Richardson M; Kearns B; Pickett A; Smith C; Knappe DRU: Legacy and Emerging Perfluoroalkyl Substances Are Important Drinking Water Contaminants in the Cape Fear River Watershed of North Carolina. Environmental Science & Technology Letters. 2016

[2]Strynar M, Dagnino S, McMahen R, Liang S, Lindstrom A, Andersen E, McMillan L, Thurman M, Ferrer I, Ball C. Identification of Novel Perfluoroalkyl Ether Carboxylic Acids (PFECAs) and Sulfonic Acids (PFESAs) in Natural Waters Using Accurate Mass Time-of-Flight Mass Spectrometry (TOFMS). Environ Sci Technol. 2015

Table 3. PFAS Concentrations (ng/L)

Location	Quantified Using Targeted Analysis											Quantified Using Non-Targeted Analysis					Flag
	GenX	Legacy PFAS										PFMOAA	PFO2HxA	PFO3OA	PFESA BP1	PFESA BP2	
		PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFBS	PFHxS	PFOS						
GW0817 Intake	-	-	21.7	18.4	10.9	-	-	-	-	-	-	34.1	307.0	-	-	-	
GW0817 Outfall	81.7	30.0	30.0	22.5	14.1	9.6	-	-	-	-	-	574	57.8	31.6	-	3,640	
Insitu-1	307*	-	-	-	-	-	-	-	-	-	-	327	78.6	10.6	-	68.0	
LTW-01	19,100	162	224	19.5	36.7	60.9	-	-	-	-	-	23,500	5,090	1,630	-	6,060	3
LTW-01 D	17,100	161	251	18.8	39.7	63.3	-	-	-	-	-	26,500	4,680	1,440	-	5,270	3
LTW-01 MS	26,700*	161	251	18.8	39.7	63.3	-	-	-	-	-	24,900	5,210	1,300	-	8,080	3
LTW-01 MSD	21,500	165	247	21.3	38.1	59.2	-	-	-	-	-	26,900	5,750	1,500	-	6,440	3
LTW-02	5,990	56.8	232	-	-	-	-	-	-	-	-	44,300	3,250	1,190	-	281	3
LTW-03	6,130	130	601*	-	11.5	-	-	-	-	-	-	108,000	5,420	1,380	-	168	3
LTW-04	9,720	328*	1,030	22.6	43.0	-	-	-	-	-	-	83,000	5,550	1,320	14.1	1,590	3
LTW-05	41,000*	385*	1,860	85.7	407*	-	-	-	-	-	-	285,000	21,200	13,500	-	3,810	3
MW-IS	6,540	105	239	14.3	33.8	70.7	19.7	-	-	-	-	24,400	1,680	590	-	6,860	3
SMW01	1,520	11.1	20.3	-	-	10.5	-	-	-	-	-	1,500	242	119	-	635	1
SMW-05P	13,700	59.7	226	74.3	126	1,960	-	-	-	-	-	93,600	4,660	1,590	78.5	1,510	3
SMW-06B	22,700	447*	1,400	96.6	186	2,100	-	-	-	-	-	738,000	38,600	13,300	20,600	12,300	3
SMW-09	12,800	419*	273*	62.2	39.2	38.8	-	-	-	-	-	12,600	-	399	24,500	2,460	3
SMW-10	10.7	-	-	-	-	-	-	-	-	-	-	283	-	-	-	-	
SMW-11	2,580	24.8	26.0	-	-	23.9	-	-	-	-	-	5,650	330	-	-	389	2
SMW-12	767	16.4	20.8	-	-	-	-	-	-	-	-	3,670	206	-	-	-	1

Flag Codes:

dash "-" = concentration below limit of detection of 10 ng/L
1 = Samples Diluted 25X
2 = Samples Diluted 50X
3 = Samples Diluted 100X
* = analyte outside range of calibration curve after dilution